

## A LEVEL

*Examiners' report*

# COMPUTER SCIENCE

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**H446**

For first teaching in 2015

## H446/01 Summer 2019 series

Version 1

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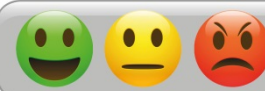
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## Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

## Paper 1 series overview

H446/01 (Computer Systems) is one of two examined components for the GCE A Level Computer Science. This component focuses on:

- The characteristics of contemporary processors, input, output and storage devices
- Software and software development
- Exchanging data
- Data types, data structures and algorithms
- Legal, moral, cultural and ethical issues

To do well on this paper, candidates need to be able to demonstrate and apply knowledge across all of the topics listed above in different contexts.

Throughout the paper candidates did not gain credit where they did not utilise or refer to the data given in the question when instructed to do so.

Fundamental definitions were, at times, not clearly expressed. This was particularly evident in the database questions.

Centres must be aware of the need to cover the whole of the specification and make use of the appendices to the specification, specifically section 5d. Centres should take note of the CSS that candidates are expected to have an awareness of.

### ***Candidate performance overview***

Candidates who did well on this paper generally did the following:

- wrote a function correctly in 2d.
- applied knowledge of compression appropriately in 4e.
- completed the function correctly in 5c.
- offered a balance discussion with a supported conclusion in 5e, 9 and 11a.

Candidates who did less well on this paper generally did the following:

- demonstrated limited discussion in 5e, 9 and 11a.
- showed poor understanding of databases in 7a, bii, c and d.
- did not apply their response to the given scenario, particularly in 3c, 5d and 8f.

demonstrated a lack of familiarity with CSS in 11c.

## Question 1 (a)

- 1 A company releases an in-home virtual assistant called 'Bertie Butler'.

The device, when placed in a room, listens out for the phrase "Hey Bertie". When someone says that phrase it then listens to the question that follows and tries to give a relevant answer.

Bertie Butler has a number of built-in input and output devices.

- (a) Name **one** input device and **one** output device that might be part of Bertie Butler. For each device give a reason for it being built into the virtual assistant.

Input Device Name: .....

Input Device Reason: .....

.....

Output Device Name: .....

Output Device Reason: .....

.....

[4]

Virtually all candidates correctly named appropriate input and output devices. Fewer candidates went on to give appropriate reasons, many were too generic to be creditworthy at this level of study e.g. 'Speaker – to output the response'

## Question 1 (b)

The Bertie Butler device runs off an embedded operating system.

- (b) Define the term 'embedded operating system'.

.....

.....

.....

..... [2]

Most candidates demonstrated their understanding that an embedded operating system (OS) is specific to the hardware or purpose. Too many stated that an embedded OS is 'embedded in the device' which is insufficient at this level of study. The candidate must clearly demonstrate their understanding of what 'embedded' means.

Question 1 (c) (i)

- (c) Bertie Butler's circuitry is designed to only listen out for "Hey Bertie" under certain circumstances, which are:

The privacy button (P) must be off and the microphone must generate a signal (S) to say a sound has been heard.

- (i) Complete the truth table for whether the device is listening (L).

P	S	L
False	False	
False	True	
True	False	
True	True	

[2]

Well answered by most candidates with some opting for a different representation of True/False in their response. These responses, where correct, were condoned but centres would best advise candidates to use the representations given in the context in future series.

Question 1 (c) (ii)

- (ii) Draw logic gates to represent the circuitry needed.

[3]

Generally, candidates responded well to this question, but some candidates used incorrect logic gate representations. Centres should remind candidates of the acceptable boolean algebra logic gate representations see specification appendix 5d.

Question 1 (d)

- (d) The Bertie Butler machine uses a multicore processor.

Define the term 'multicore processor'.

.....

.....

.....

..... [2]

Too many candidates defined a multi core processor as 'a processor with multiple cores' this is not creditworthy at this level of study. Candidates must demonstrate their understanding of a core being a processing unit within a processor.

## Question 2 (c)

(c) Show the result of using Run Length Encoding to compress the sequence:

CCCCOLLCCCCCMOCCCC

.....

.....

.....

..... [3]

Well answered by most candidates, demonstrating clear understanding of Run Length Encoding as a method of compression.

## Question 2 (d)

The survey takers want to find out the longest continuous sequence of cars in any given chunk of data. For example, in the data

CCMCCCCLLCCC

the longest sequence would be 4.

(d) Write the function `longest` which takes in a string of characters as an argument and returns an integer representing the longest continuous sequence of Cs.

[5]

It was pleasing to see more candidates than in previous series offering a response to this type of question. Many candidates scored well. There were two common errors. Firstly, some candidates correctly declared a function as required but then did not return a value from that function, this is a fundamental knowledge requirement at this level of study. Secondly, some candidates wrote fully functioning code to return the longest sequence of any character rather than the longest sequence of Cs. Hence, not addressing the question. Candidates should be reminded to read the question carefully, particularly where questions require them to write code/algorithms. See exemplar 1 which scored full marks.



## Exemplar 1

```

function longest(Sequence):
    length = len(Sequence);
    longest = 0 : current = 0;
    for (i = 0 : i < length : i = i + 1):
        if (Sequence[i] == "c"):
            current = current + 1;
        else:
            if (current > longest):
                longest = current
            current = 0
    return (longest)

```

Question 3 (b)

(b) State what the purpose of the program is.

.....  
 ..... [1]

Many candidates achieved full marks on part (a) and went on to achieve the mark on part (b). Those who did not score well on part (a) could not determine the purpose of the program and therefore did not achieve the part (b) mark.

Question 3 (c)

(c) Explain which registers are used and their values when the line `STA count` is **executed** and the accumulator is holding the value 9. The label `count` refers to memory location 16.

.....  
 .....  
 .....  
 ..... [2]

It is encouraging that many more candidates are appropriately applying their response to the scenario, in this type of question, than in previous series. However, there are still some candidates giving a description of the order of data movement between registers without referring to the data or address values/labels given in the question. Candidates should be reminded to refer to the values given in this type of question in their response.

### Question 3 (e)

- (e) The code uses direct addressing. Describe **one** other mode of addressing.

.....

.....

.....

..... [2]

Many candidates correctly cited another mode of addressing outlined in the specification but descriptions invariably lacked clarity, with the exception of Immediate Addressing.

### Question 4 (a)

- 4 Traditionally films have been distributed on optical media such as DVDs.

- (a) Giving an example other than DVDs, describe what is meant by the term 'optical media'.

.....

.....

.....

..... [2]

### Question 4 (b)

- (b) Give **one** advantage of films being distributed using optical media.

.....

..... [1]

Many candidates achieved full marks on both part (a) and (b) demonstrating their understanding of optical media.

### Question 4 (c)

Adding a DVD drive to a computer would often require the installation of a piece of software called a device driver.

- (c) State the purpose of a device driver.

.....

..... [1]

Many candidate responses were too generic for this level of study, stating that the device driver allows communication between the device and the 'computer' or 'computer system' rather than 'operating system'.

### Question 4 (d)

It is now common for people to purchase films which, rather than having a physical copy of, they can stream or download over the internet whenever they want.

- (d) Explain the advantages and disadvantages of owning films that are streamed or downloaded on demand rather than owning a physical copy.

.....

.....

.....

.....

.....

.....

.....

..... [4]

Most candidates achieved at least one advantage and one disadvantage mark. Most commonly citing access to the internet renders the film(s) accessible from anywhere. Although some candidates referred to 'on line' access which is not creditworthy.

### Question 4 (e)

Being able to stream high resolution films is only possible due to improvements in compression.

- (e) Explain why compression is important for the streaming of high resolution films.

.....

.....

.....

.....

.....

..... [3]

Generally, candidates correctly stated that buffering would be reduced. Some candidates stated that high resolution films are very large but did not then explain why it is important to compress them for streaming. Candidates should be reminded to address the question fully in their response.

## Question 5 (a)

- 5 A programmer is writing software for a firewall. She is writing code so that it keeps a track of websites that users are permitted to visit. The software stores the websites' addresses along with details about who can view them and when.

The following data is also stored about each website:

- Access level needed (1–4)
- If it is available all the time (`true`) or just lunch times and out of work hours (`false`).

So a website which is available to users of access level 2 and above, all the time, would have the details `[2, true]` stored.

A website accessible to users of access level 3 and above, only outside of work hours, would have the details `[3, false]` stored.

- (a) State the name of a data structure that could be used to store a single site's details.

.....  
..... [1]

Many candidates cited a suitable structure but some incorrectly cited an array. This demonstrates a clear misconception or lack of understanding that an array can only hold one type of data.



It was pleasing to see that many candidate responses did refer to the given example. Where this was evident, the candidate scored well. Candidates who did not refer to the example, gained little to no credit on the question.

### Question 5 (e)

The hash function is changed so there are no longer high numbers of collisions.

During busy periods the firewall is expected to check several addresses a second. It is anticipated that roughly 10 new addresses will be added to a whitelist (list of acceptable addresses) each day.

There is a debate as to whether a hash table (with the new hash function) is the best approach, or if the whitelist would be better stored in a linked list.

- (e) \*Discuss whether a hash table or linked list is better to store acceptable websites. You should compare how each structure can be searched and has data added and come to a recommendation as to which is better for the whitelist. [12]

.....

.....

.....

.....

Candidates were assessed on the quality of their extended response in this question. Most candidates correctly cited direct access as the main advantage of hash tables and access times as the disadvantage of linked lists. The level of discussion varied with most candidate responses being given Level 2.

### Question 6 (a)

- 6 A company makes anti-virus software.

Anti-virus software is an example of a utility.

- (a) Define the term 'utility'.

.....

.....

.....

..... [2]

This question was well answered with most candidates correctly stating that a utility is used for system maintenance.

### Question 6 (b)

- (b) State how an application differs from a utility.

.....  
..... [1]

This question was generally well addressed by candidates with most demonstrating understanding that applications perform tasks for the user as opposed to the computer.

### Question 6 (c)

In order to keep up to date with the latest virus threats, the company is continually updating their software.

The programmers use an Extreme Programming approach when developing the updates.

- (c) Explain what is meant by Extreme Programming and why it is a suitable approach in this case.

.....  
.....  
.....  
..... [4]

Most candidates correctly stated that extreme programming is both agile and utilises paired programming. Fewer candidates discussed its focus on high quality code.

### Question 6 (d)

- (d) Explain why the programmers of anti-virus software may make use of virtual machines when developing the updates.

.....  
.....  
.....  
.....  
.....  
..... [3]

Many candidate responses described the virtual machine rather than explaining why they would be used in this scenario. Candidates should be reminded to apply their knowledge to the scenario when the question requires them to do so.



### Question 6 (e)

When running the anti-virus software, an operating system uses a scheduling algorithm to determine an allocation of CPU time to the anti-virus software.

- (e) Explain why a First Come First Served scheduling algorithm would **not** be suitable in this situation.

.....

.....

.....

..... [2]

Those candidates who demonstrated a clear understanding of 'First Come First Served' scheduling scored well on this question. Some candidates incorrectly referred to priorities and interrupts in their responses which gained no credit.

### Question 6 (f)

In the late 1990s the CIH virus hit headlines because it was able to overwrite and destroy the contents of a computer's BIOS.

- (f) Describe what the effect would be of a computer having its BIOS overwritten.

.....

.....

.....

..... [2]

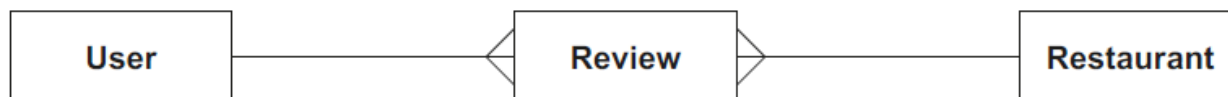
This question was well attempted by most candidates.



Question 7 (a)

- 7 RestaurantReview is a website that allows users to leave reviews and ratings for different restaurants.

The website uses a database with the following structure.



The database management system ensures referential integrity is maintained.

- (a) Explain what is meant by referential integrity, giving an example which refers to the database described above.

.....

.....

.....

.....

.....

..... [3]

In general, this question was poorly attempted by most candidates on two counts. Firstly, many candidates could not clearly explain the term 'referential integrity'. Secondly, some examples incorrectly stated that when a review is deleted, the corresponding User/Restaurant needs to be deleted.

Question 7 (b) (i)

- (b) Each review includes a score out of 5. When the score is entered on the website it is checked in the browser to ensure a number no higher than 5 has been entered. It is then checked again on the server.

- (i) State what is meant by the term 'server'.

.....

..... [1]

Many candidates did not clearly define the term. Candidates should be reminded that they must clearly express fundamental definitions at this level of study.

### Question 7 (b) (ii)

- (ii) Explain why it is important that the review score that the user entered is also checked server-side.

.....

.....

.....

..... [2]

Again, many candidates did not clearly explain the importance of a server-side check in this scenario.

### Question 7 (c)

Whenever a review is added to the system, the restaurant's average rating is updated. This transaction is ACID.

The A in ACID refers to Atomic.

- (c) Describe what is meant by the term 'Atomic' in the context of ACID transactions. You should refer to the example of a review being added.

.....

.....

.....

..... [2]

This question was generally well attempted by most candidates. Those who did not gain credit referred to atomic being the lowest level of detail which is incorrect in this context.

### Question 7 (d)

- (d) State what the letters CID refer to in ACID.

C .....

I .....

D .....

[3]

Well attempted by most candidates. In general, candidates either scored three or zero marks.

### Question 7 (e)

The database previously stored reviews using the ASCII character set. ASCII uses 1 byte per character. It is decided to switch to the Unicode UTF-32 character set which uses 4 bytes per character.

- (e) Give an advantage and disadvantage of changing character sets from ASCII to Unicode UTF-32.

Advantage .....

.....

Disadvantage.....

.....

[2]

Some candidates' advantages/disadvantages were not clear enough to gain credit e.g. 'disadvantage – reviews take up more space' is not sufficient at this level of study. Candidates should clearly demonstrate understanding that 'reviews take up more storage'.

### Question 8 (e)

(e) Write extra code so the program also displays the remainder.

.....

.....

.....

..... [2]

Although most candidates gained credit for correctly outputting their calculated remainder, many lost marks for an incorrect calculation.

### Question 8 (f)

The program is compiled. The first stage is Lexical Analysis.

(f) Referring to examples in the code in Fig. 8.1, explain what happens in Lexical Analysis.

.....

.....

.....

.....

.....

..... [3]

This question was poorly attempted by most candidates. Although, many explained what happens during Lexical Analysis few went on to refer to examples from the given code, hence not gaining credit. Candidates should be reminded that they must refer to examples when the question requires them to do so.

### Question 8 (g)

(g) State the name of the stage of compilation that directly follows Lexical Analysis.

.....

..... [1]

Most candidates correctly stated 'Syntax Analysis' as the next stage of compilation.

## Question 9

9\* Discuss the positive and negative impacts computers are having on the environment.

.....

.....

.....

.....

.....

..... [9]

Candidates were assessed on the quality of their extended response in this question. The negative impacts of computers on the environment were generally well addressed by most candidates with fewer citing a balanced range of positive impacts. The level of discussion therefore varied with most candidate responses being given Level 2.

## Question 10 (a)

10 (a) Show how the binary number 01011110 is represented in hexadecimal.

.....

.....

.....

..... [1]

Although this question was well answered by most candidates, in some cases, incorrect workings rendered an incorrect hexadecimal answer. Candidate should be reminded to double check their workings.

## Question 10 (b)

(b) Show how the hexadecimal number 9B is represented in denary.

.....

.....

.....

..... [2]

A relatively high proportion of candidates presented their answer to this question in binary as opposed to denary, hence, losing credit. Candidates should be reminded to read the question carefully.

### Question 10 (c)

- (c) Show how the denary number  $-87$  is represented in sign and magnitude binary.

.....

.....

.....

..... [2]

Some candidates demonstrated confusion between sign and magnitude and two's complement binary representation of negative number.

### Question 10 (d)

- (d) Complete the following binary subtraction. Show your working.

$$\begin{array}{r} 01001001- \\ \underline{00101111} \end{array}$$

[2]

Many candidates achieved full marks on this question. Those who did not, generally did not show evidence of binary subtraction. Converting the binary numbers to denary, carrying out the subtraction and converting the result back to binary does not evidence binary subtraction.

### Question 10 (e)

- (e) The floating point binary number  $010011\ 011$  consists of a 6-bit mantissa and 3-bit exponent, both represented in two's complement. Convert the number to denary, showing your working.

.....

.....

.....

.....

.....

..... [3]

This question was better attempted than similar questions in previous series. Most candidates clearly demonstrated the 'floating' of the point the correct number of places.

### Question 10 (f)

- (f) Show the denary number  $-5.25$  in floating point binary form representing the mantissa and exponent in two's complement, using as few bits as possible. Show your working.

.....

.....

.....

.....

.....

.....

.....

..... [4]

Many candidates did not convert the original denary number to the correct fixed-point binary representation. Others who did convert to fixed point correctly did not go on to represent their floating-point solution in as few bits as possible.

### Question 11 (a)

- 11 A web development company makes its money building websites for other companies.

- (a)\* The web development company is looking to recruit a programmer to build websites.

Discuss the technologies the programmer would need to know and use and the importance of each one.

.....

.....

.....

..... [9]

Candidates were assessed on the quality of their extended response in this question. Most candidates correctly cited HTML, CSS and JavaScript as the basic technological requirements. The level of discussion varied with many extending their response to include other appropriate technologies. This question was generally well answered by most candidates.

Question 11 (b)

(b) Part of a website's code is shown below.

```
<head>
  <title>Orville's Oranges</title>
  <link rel="stylesheet" type="text/css" href="mainStyle.css">
</head>
```

Explain the meaning of the code.

.....

.....

.....

..... [2]

Explanations were, in many cases too superficial for this level of study. See exemplar 2 which shows the level of detail required in the explanation to gain credit.

## Exemplar 2

- ' The title on the browser tab of the HTML page will be Orville's Oranges.
- The HTML file is linked to a CSS file called "mainStyle.css" [2]

Question 11 (c)

(c) The site also contains the following code.

```
<div class="offer">All oranges 50% off.</div>
```

Complete the CSS code that would make any div elements of the class offer have an orange border.

```
.....{
    border-style: solid;
    .....
}
```

[2]

It was evident that some candidates did not have the required awareness of the CSS class and property definitions outlined in the specification appendix 5d. Those candidates who did, generally scored well on this question.



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